

# Entrepreneurial Ecosystem Research: Bibliometric Mapping of the Domain

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## ABSTRACT

The entrepreneurial ecosystem stream of research is relatively new, yet it has started to attract the attention of scholars across a range of disciplines including international business and international entrepreneurship. Review studies are needed to consolidate the research and to illustrate the status quo and present visions for research going forward. This study aims to do so by applying bibliometric process technique. The present study summarizes the key countries and institutions, source journals, scholars and publications, and key themes encompassing the domain of entrepreneurial ecosystem research up to 2019. The findings illustrate an exponential growth of research covering a wide array of disciplines and top journals, observe several influential scholars and their collaboration networks, and find that the studies remain distinctly practitioner focused. In addition, six themes within the research domain are identified. The multilevel analysis gives a comprehensive overview of the entrepreneurial ecosystem domain.

## KEYWORDS

Bibliometrics, Dimensional Entrepreneurship, Entrepreneurial Ecosystems, Visualization, VOSviewer

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## 1. INTRODUCTION

Research on entrepreneurial ecosystems (EEs) constitutes a new-found stream of studies explaining how this complex socioeconomic system supports entrepreneurial activities and value creation for the larger community. Despite numerous definitions of EEs (Malecki, 2018), the concept is broadly defined as a ‘set of interdependent actors and factors coordinated in such a way that they enable productive entrepreneurship’ (Stam, 2015, p. 1765). Over the last decade, especially the past few years, EEs have started to attract the vast interest of scholars across a range of disciplines (e.g., management, economic geography, strategy, entrepreneurship). The increased attention over time has created the need to consolidate fragmented findings across countries, institutions, journals, scholars and research avenues within this young but proliferous topic (Audretsch et al., 2019).

The ecosystem concept has found its way into academia, industry and policy. Starting as an ecological metaphor (Moore, 1993) to explain the system-level complexities, the ecosystem concept has subsequently become an attractive framework to explain different system designs (Ritala & Almpantopoulou, 2017), influencing the creation of multiple research streams. They include entrepreneurial, knowledge, business, innovation and digital platform ecosystems, among others (Aarikka-Stenroos & Ritala, 2017; de Reuver et al., 2018; Hakala et al., 2020; Jacobides et al., 2018; Scaringella & Radziwon, 2018). The EE focuses on the actor interrelations by exploring the entrepreneurship, the system infrastructure and its underlying processes (Van De Ven, 1993), with its roots derived from more established concepts of clusters, industrial districts and regional innovation systems (Acs et al., 2016; Autio et al., 2014; Spigel & Harrison, 2018). Subsequently, the EE combines a multitude of research streams, making the present study relevant to provide a timely overview of EE research.

Utilising bibliometric methods to analyse the main facets of the status quo and to present the themes derived from the literature is important since, to our knowledge, no bibliometric analysis is available to determine the countries, institutions, publication venues, scholars and central themes that are vital to advancing the EE literature. Our study therefore sheds light on the statistics, intellectual foundations and structural themes in the EE domain and highlights the current state of the research. We extract data from academic databases and apply specialised software to analyse and visualise literature. This multilevel approach benefits present and future scholars by providing a clear snapshot of existing research efforts. Although recent contributions have applied bibliometric methods in the EE context (Alvedalen & Boschma, 2017; Credit et al., 2018; Malecki, 2018), our study is distinctive and complementary, being the first full-fledged bibliometric analysis of the emerging domain.

## 2. METHODOLOGY

Bibliometric analysis provides an overview of the current progress in any research stream by analysing metadata derived from academic research databases (Osareh,

1996). Metadata consist of key factors, such as source titles, abstracts, keywords, authors, references and the number of times the publications have been cited. The information available in such databases can be used to develop different analyses and visualisations that offer insights into the research arena. A bibliometric study helps in understanding the current size of and advancements in any research field, via publication and citation records, as well as in identifying intellectual structures and thematic clusters, together with associated findings (Zupic & Čater, 2015).

Compared with other literature review methods, bibliometric studies are potentially more rigorous, less biased and present an aggregate view of the scientific literature in a particular field, while complementing meta-analyses and systematic literature reviews (Zupic & Čater, 2015). They have been successfully applied in organisation and management studies in general (Nerur et al., 2008; Ramos-Rodríguez & Ruíz-Navarro, 2004) and in entrepreneurship and international business in particular (Chabowski et al., 2013; Dabić et al., 2019; Jiang et al., 2020; Lampe et al., 2019; Schildt et al., 2006). Besides having limited coverage of EE research, the studies utilising bibliometric methods in the EE context (Alvedalen & Boschma, 2017; Credit et al., 2018; Malecki, 2018) do so either superficially or to serve a different purpose. As opposed to Malecki's (2018) study, whose limited bibliometric evidence (citation data) only highlights the current prevalence of EEs over related concepts (entrepreneurial environment/infrastructure/system) and lists the most-cited works, our study utilises a broad array of bibliometric data and techniques to map the domain of EE research from various perspectives (countries, institutions, journals, articles and authors). Another bibliometric study (Credit et al., 2018) narrowly focuses on the usage of secondary data within a broader research domain of ecosystem-related topical areas, whereas only 37 out of 510 reviewed articles fall under the topical area of EE. A similar tendency can be observed until 2015, where the number of journal articles was insufficient to establish a good bibliometric overview (Alvedalen & Boschma, 2017). The research process (Figure 1) is consistent with the principles of systematic reviews (Denyer & Tranfield, 2009) and scientometrics (Ferrara & Salini, 2012; Glänzel & Thijs, 2012; Nederhof, 2006), as well as with the recommendations for conducting bibliometric reviews in organisation and management studies (Zupic & Čater, 2015).

## 2.1. Research Process

The research process is divided into six steps: formulation, identification, selection, confirmation, analysis and synthesis (Figure 1). We explain each step in detail to enhance our study's transparency and inclusivity, while maintaining its illustrative and exploratory nature (Denyer & Tranfield, 2009).

### 2.1.1. Formulation

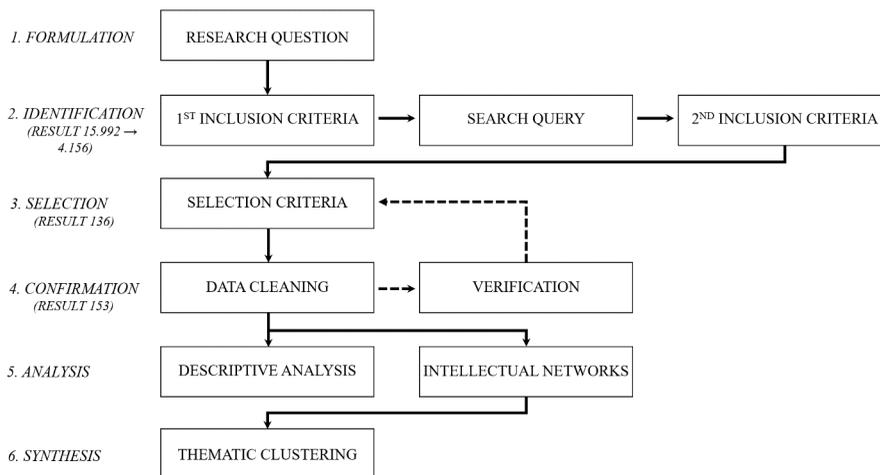
*Purpose and research questions.* Our study aims to create a comprehensive representation of EE research by identifying, classifying, visualising and synthesising existing scholarly publications in the subject area. To fulfil this purpose, we formulate and address the following research questions (Nguyen et al., 2018):

*Who are the main scholars taking the EE research forward?*

*Where are they from, and what are their institutional affiliations and collaboration outcomes?*

*Which research themes are represented in the EE literature?*

**Figure 1. Process of bibliometric analysis**



### 2.1.2. Identification

To identify the most relevant publications for the bibliometric study, we focused on three aspects: first inclusion criteria, data query and second inclusion criteria.

*First inclusion criteria.* Following Wang and Chugh (2014), we established the search parameters for choosing an appropriate electronic database, listed a set of keywords and identified a reasonable timeframe. The most well-known academic databases are Google Scholar, Science Direct, ProQuest, EBSCO, SCOPUS and Clarivate Analytics Web of Science (WoS). The latter two databases are more quality driven but suffer from inaccuracies in citation data (N. J. van Eck & Waltman, 2019). Despite the WoS Core Collection’s comprehensive overlap with SCOPUS (Martín-Martín et al., 2018), it is still the most widely used database for bibliometric studies in general (Zhu & Liu, 2020) and management and organisation research in particular (Zupic & Čater, 2015). Moreover, it was recently utilised for a bibliometric study in the EE domain (Credit et al., 2018), making WoS our preferred choice. We then identified a set of keywords (Müller-Seitz, 2012) that accurately captured the EE phenomenon. This entailed choosing from a comprehensive list of keyword searches unrelated to the EE topic in order to mitigate the risk of missing relevant studies. We also did not limit the start of the publication period but set the cutoff date to December 2019.

*Data query.* The title, abstract, author keywords and Keywords Plus® fields were searched in the WoS database (Danese et al., 2018). We then built the query by combining keywords in a sequence and introduced the Boolean operator ‘OR’. We also used truncation to control for keyword variations. Because the key theme was ‘entrepreneurial ecosystem’, the keyword queries were as follows: (entrepreneur\* OR startup\* OR start-up\*) AND (ecosystem\* OR system\* OR communit\*). The combination and choice of keywords were determined by the most common terms used by academics (‘entrepreneurial ecosystem’, ‘national system of entrepreneurship’) and practitioners (‘start-up ecosystem/community’). The search query generated 15,992 results.

*Second inclusion criteria.* Following Dada (2018) and Kauppi et al. (2018), we only considered peer-reviewed journal articles with available full texts. Book chapters, conference articles, extended abstracts, among others, were excluded. Only journal articles were chosen because they count as supported knowledge and will likely expand the field (Keupp et al., 2012). Furthermore, mainstream academic journals and common scientific knowledge are written in English. We acknowledge that this criterion might have led us to ignore some works in other languages, for example, in German (Deng, 2012). Lastly, we selected WoS categories relevant to EE research, namely management, business, economics, regional urban planning, development studies, urban studies and area studies. Other categories, such as engineering, history, agriculture, medicine and forestry, were unrelated to EE research. The refined query generated 4,156 results.

### 2.1.3. Selection

*Selection criteria.* We reviewed the titles of the papers that matched our keyword searches; where necessary, we examined the abstracts and the introduction sections to narrow down the list of sources. Papers on related topics about ecosystems, such as business, innovation, knowledge and entrepreneurial university ecosystems, were omitted. The relevant articles thus identified were added to the WoS marked list. Next, we assessed the Scimago Journal Rank (SJR) to select only high-quality academic journals acknowledged by the research community. SJR indicators use Google’s PageRank algorithm to rank the quality of the sources and thus identify the most attractive journals, without any thematic limitations (cf. Chartered Association of Business Schools ranking in business). This aided our multidisciplinary approach. The SJR has been found to be an adequate tool for bibliometric studies (Johnson et al., 2012). It compares well with alternative journal ranking criteria (Falagas et al., 2008) and has since been applied in several bibliometric studies across different research domains (e.g., Hall, 2011; Zacca-González et al., 2014). All selected papers in this study were published in the SJR in the first (Q1) and the second (Q2) quartile journals. After filtering the WoS results with the SJR, we selected 136 articles for our study.

#### 2.1.4. Confirmation

*Data cleaning.* We downloaded the text corpus as a plain text format appropriate for bibliometric investigation. To explore our data and determine the cleaning needs of the text corpus, we utilised the widely recommended VOSviewer (N. J. van Eck & Waltman, 2010). We extended Sinkovic's (2016) proposed data cleaning process to manually correct the diacritical marks in the authors' names, cross-check their initials and correct other relevant information.

*Dataset verification.* For external assessment (Nofal et al., 2018), we sent the updated publication list to two experts with robust publication records in EEs, who verified the list and identified another six overlooked articles. To reduce the possible omission of other relevant studies, we performed a co-citation analysis (Small, 1973) in VOSviewer to examine their collective reference lists for frequently cited articles (Dada, 2018; Vrontis & Christofi, 2019). This resulted in the addition of 11 selected articles. The confirmation process concluded with another round of data cleaning. The final list consisted of 153 journal articles.

#### 2.1.5. Analysis

*Descriptive analysis and intellectual networks.* We sought to analyse the bibliometric data through analysis tools that would best fit our study's aims and provide clear answers to our research questions. We included co-authorship and direct citations, as both are important to the aims. Co-authorship indicates how authors, organisations and countries are linked; it represents the most common social network structure (Peters & Van Raan, 1991). The direct citation-based approach is then a newer way to measure direct relatedness between publications compared with co-citation and bibliographic coupling (Boyack & Klavans, 2010; N. J. van Eck & Waltman, 2014). We also used the total link strength (TLS) as a weight attribute to map the strength of the citation links between items, as recent studies have suggested (e.g., van Eck & Waltman, 2020). The TLS accounts for how many times the links occur. For example, one author has multiple co-authors (links), while with some of them, he/she has co-authored articles multiple times. This enabled us to map the items' density. Thus, we explored and visualised the dynamic attributes of EE research and uncovered its intellectual structures essential to those attributes. The analysis tool that would best fit these purposes was found to be in VOSviewer, which was used to obtain the results of the bibliometric analysis across five categories: countries, institutions, journals, authors and publications.

#### 2.1.6. Thematic Synthesis

*Identification of clusters and thematic synthesis.* To determine the interrelatedness of the research output and identify distinctive clusters in the research domain, we used a clustering technique based on direct citations (van Eck & Waltman, 2017). Compared with other types, direct citations (also known as cross-citations) yield more accurate information (Klavans & Boyack, 2017; Waltman & van Eck, 2012). The clusters generated by VOSviewer based on direct citations were further content analysed and

labelled according to the most commonly recurring or overarching themes. In the next section, we present the results of our bibliometric analysis, followed by the thematic synthesis of the articles in each cluster.

### 3. RESULTS OF BIBLIOMETRIC ANALYSIS

We analysed a sample of 153 articles on EE (Q1=106, Q2=47), published across 57 (Q1=34, Q2=23) journals during the period 1993–2019 (Figure 2). Our results show that EE research has been conducted in 37 countries and 232 institutions. Although the trends show only eight articles published between 1993 and 2012, the EE phenomenon has gained more traction in mainstream journals after 2013. Of the analysed studies, 90.8% (139) have been published in the last five years, with 2019 accounting for 49.7% (76) of the total.

In terms of statistics, 153 journal articles have been published by 331 scholars; of these, 30 are single-author papers, and 123 are co-authored. Overall, the 331 authors have 406 mentions (41 authors with two or more publications and 290 with only one publication each). The articles per author ratio is 0.46, the authors per article ratio is 2.16, and the publications have on average 2.65 authors per article. These figures suggest that EE research crosses different disciplines and that comprehending the complexities of the EE phenomenon requires collaborative efforts. The compounded annual growth rate of published articles in the assessed period is 36%; on average, each article has received 20.12 citations.

#### 3.1. Countries and Institutions

Thirty-seven countries have engaged in EE research, resulting in 153 published articles with a total of 236 affiliations<sup>1</sup> (Table 1). The most productive country by far is the United States (US) (72 articles), followed by the United Kingdom (UK) (36) and Germany (16), jointly representing over half of the associated publications. Overall, the 10 most productive countries account for approximately 78% (184) of the articles and drive the research agenda.

Unsurprisingly, the US and the UK have received the maximum traction in terms of citations (1,666 and 1,193, respectively). This may be due to the following reasons: (1) Overall, more articles produce more citations. (2) The institutions in these countries are frontrunners in funding EE research. (3) Works published in the initial years receive more citations. Our TLS results confirm this; both the US and the UK are highly cross-cited by other countries and by each other. The 10 most cited countries account for 91% (4,754 citations) of the research traction, clearly indicating where scientific knowledge on EE is created and sourced.

Furthermore, countries and research institutions are aligned, arguably because country-level publication and citation counts are indicative of the research institutions' locations and agglomeration. Hence, in terms of linked productivity (323 articles), the top 10 institutions are distributed as follows: 6 in the US (40 articles), 2 in the UK (6 articles) and 1 each in the Netherlands and Hungary (6 articles each). These

Figure 2. Data overview and number of articles per year

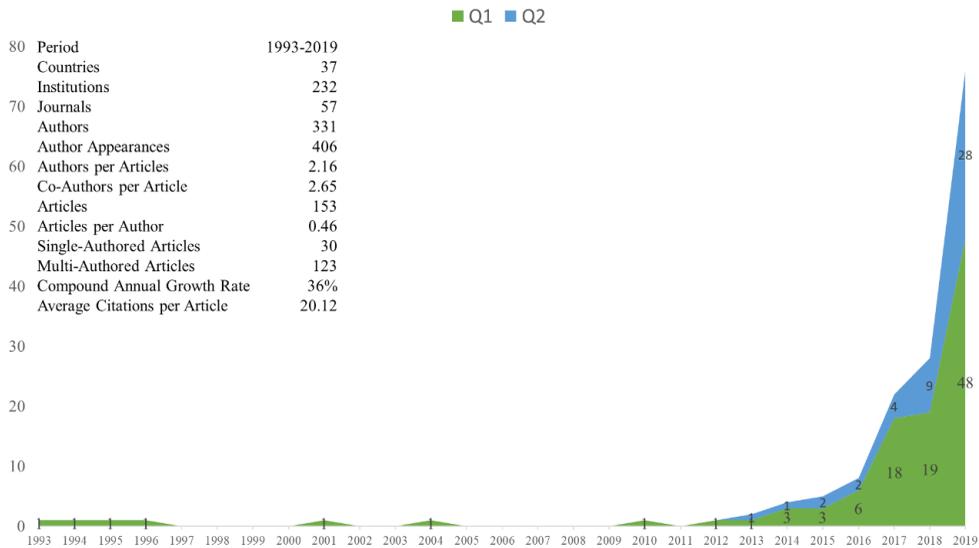


Table 1. Top 10 most impactful countries

Countries*	# Articles	% Articles	Total %	TLS	Countries*	# Citations	% Citations	Total %	TLS
US	72	30,51%	30,51%	818	US	1 666	31,87%	31,87%	818
UK	36	15,25%	45,76%	765	UK	1 193	22,82%	54,69%	765
Germany	16	6,78%	52,54%	239	Netherlands	409	7,82%	62,51%	309
Spain	11	4,66%	57,20%	140	Hungary	320	6,12%	68,63%	152
Netherlands	10	4,24%	61,44%	309	Finland	268	5,13%	73,76%	123
Canada	9	3,81%	65,25%	114	France	262	5,01%	78,77%	68
Italy	9	3,81%	69,07%	134	Belgium	236	4,51%	83,28%	56
China	9	3,81%	72,88%	89	Canada	169	3,23%	86,51%	114
Hungary	6	2,54%	75,42%	152	Switzerland	130	2,49%	89,00%	109
Finland	6	2,54%	77,97%	123	Germany	101	1,93%	90,93%	239
Others (27)	52	22,03%	100,00%		Others (27)	474	9,07%	100,00%	
<b>Total:</b>	<b>236</b>	<b>100,00%</b>			<b>Total:</b>	<b>5 228</b>	<b>100,00%</b>		

Note: \* all affiliations

universities account for 18% (58 articles) of the publications. Although 37 countries have produced EE research, many institutions seem to have undertaken collaborative projects.

Regarding the citation count by university, the field is more level: the US with 3 organisations (981 citations), the UK with 2 (762), and 1 each from the Netherlands (353), Hungary (320), Finland (258), Switzerland (236) and France (236). These top universities account for 47% (3,146) of all citations. This strong citation count is

**Table 2. Top 10 most impactful institutions**

Institutions*	# Articles	% Articles	Total %	TLS	Institutions*	# Citations	% Citations	Total %	TLS
George Mason University	9	2,79%	2,79%	361	George Mason University	509	7,61%	7,61%	361
University of Tennessee	9	2,79%	5,57%	196	Imperial College London	508	7,59%	15,20%	196
Indiana University	8	2,48%	8,05%	235	Utrecht University	353	5,28%	20,48%	337
University of North Carolina	7	2,17%	10,22%	94	University of Pécs	320	4,78%	25,26%	201
Utrecht University	6	1,86%	12,07%	201	Aalto University	258	3,86%	29,11%	134
University of Pécs	6	1,86%	13,93%	337	University of Edinburgh	254	3,80%	32,91%	218
George Washington University	4	1,24%	15,17%	51	Ghent University	236	3,53%	36,44%	71
University of Edinburgh	3	0,93%	16,10%	218	University of California	236	3,53%	39,96%	71
Imperial College London	3	0,93%	17,03%	196	University at Albany	236	3,53%	43,49%	71
Babson College	3	0,93%	17,96%	129	Mines ParisTech	236	3,53%	47,02%	71
Others (222)	265	82,04%	100,00%		Others (222)	3 545	52,98%	100,00%	
<b>Total:</b>	<b>323</b>	<b>100,00%</b>			<b>Total:</b>	<b>6 691</b>	<b>100,00%</b>		

Note: \* all affiliations

supported by the TLS, which shows all top institutions as highly cross-cited by other institutions and by one another, making them central to the research field.

Although not entirely clear, country-level and institutional-level indicators are worth exploring. The country account is an aggregate representation of the geographical allocation of institutions, whereas the institutional level highlights researchers' affiliations and co-authorship patterns. For example, Zoltan J. Acs is affiliated with George Mason University (US), Imperial College London (UK) and the University of Pécs (Hungary) and has published 8 articles with 13 co-authors. His collaborative productivity and citation accounts are concurrently reflected in multiple countries and institutions. In sum, descriptive measures at the country and the institutional levels offer a simple picture of EE research hotspots although connections are based at the author level.

### 3.2. Source Journals

The assessment of journal sources clarifies key topics of interest in EE research and the progress within them. In total, 69 journals from multiple disciplines, beyond business and management, have published papers on EE. The SJR shows that 57 of these journals are ranked as Q1 and Q2, 5 as Q3 and Q4, while 7 are missing from the SJR system. Applying the SJR classification to the WoS results, we find that WoS has included lower-quality journals, many of which belong to the bottom half of the SJR list; some are not even indexed. We consequently exclude those. In the top

quartile of the journals, 40 belong to the business and management fields; 12 also cover economics and entrepreneurship; 9 address innovation, knowledge and policy; 2 belong to the field of computer sciences; 5 focus exclusively on economics and entrepreneurship (including finance); 7 specialise in social sciences; and 3 cover the economics and entrepreneurship and social sciences. Ten journals focus on economic geography and regional planning, which emphasise the geographical foundations of the EE phenomenon.

Tables 3 and 4 show the impact of the journals in terms of published articles and the number of citations, respectively. Regarding productivity, EE research is pursued at both Q1 (7 journals) and Q2 (3 journals) levels, and the top journals account for 54.25% of the total research output. Most of these journals have published special issues and special sections addressing the phenomenon. By far, the most important knowledge-building journal is *Small Business Economics* (31 articles), followed by the *Journal of Enterprising Communities* (8 articles) and the *Journal of Technology Transfer* (7 articles). The h-index score (Hirsch, 2005)<sup>2</sup> and TLS weights suggest that these lower-ranked journals are not at the core of the EE knowledge body although their interest is focused on the topic.

**Table 3. Top 10 most productive journals**

Title of the Journal	SJR	h-Index	# Articles	% Articles	Total %	TLS
Small Business Economics	Q1	108	31	20,26%	20,26%	227
Journal of Enterprising Communities	Q2	19	8	5,23%	25,49%	85
Journal of Technology Transfer	Q1	66	7	4,58%	30,07%	108
European Planning Studies	Q1	69	7	4,58%	34,64%	32
Industrial and Corporate Change	Q1	95	6	3,92%	38,56%	56
Intern. Entrepreneurship and Management Journal	Q1	41	6	3,92%	42,48%	65
Journal of Entrepreneurship and Public Policy	Q2	9	5	3,27%	45,75%	44
The German Journal of Economic Geography	Q2	14	5	3,27%	49,02%	62
Strategic Entrepreneurship Journal	Q1	31	4	2,61%	51,63%	73
Entrepreneurship and Sustainability Issues	Q1	12	4	2,61%	54,25%	0
Others			70	45,75%	100,00%	
<b>Total:</b>			<b>153</b>	<b>100,00%</b>		

In terms of citations, *Research Policy* (494 citations) has had the greatest impact on guiding EE literature, followed by *Small Business Economics* (396), *European Planning Studies* (289) and the *Journal of Business Venturing* (227). These journals cover the main themes of innovation, entrepreneurship and regional development, which constitute the pillars of EE. The next in line, *Harvard Business Review* (HBR), is not an academic journal per se but an industry-led influencer of academic research. We include it because Isenberg’s (2010) (Q1) ‘the big idea’, published in HBR, introduced EE into the main discourse of business studies, and HBR has remained a

Table 4. Top 10 most cited journals

Title of the Journal	SRJ	h-Index	# Citations	% Citations	Total %	TLS
Research Policy	Q1	206	494	16,04%	16,04%	89
Small Business Economics	Q1	108	396	12,86%	28,91%	227
European Planning Studies	Q1	69	289	9,39%	38,29%	108
Journal of Business Venturing	Q1	154	227	7,37%	45,66%	34
Harvard Business Review	Q3*	161	203	6,59%	52,26%	62
Entrepreneurship Theory and Practice	Q1	121	200	6,50%	58,75%	75
Journal of Technology Transfer	Q1	66	140	4,55%	63,30%	85
Strategic Entrepreneurship Journal	Q1	31	132	4,29%	67,59%	73
Journal of Small Business Management	Q1	94	131	4,25%	71,84%	41
Journal of Business Research	Q1	158	130	4,22%	76,06%	47
Others			737	23,94%	100,00%	
<b>Total:</b>			<b>3079</b>	<b>100,00%</b>		

Note: \*cited article in journal is from Q1 era.

high-impact journal despite using mostly non-citable documents for academic inquiry (ranked Q3 in 2018).

Journals from various research disciplines have taken an interest in EE. It can be argued that the research community has accepted EE as a separate field from clusters and innovation systems, papers on which have been published in higher-ranked journals. A recent bibliometric review of clusters and industrial districts (García-Lillo et al., 2018) identifies *Industrial and Corporate Change*, *Research Policy* and the *Journal of Economic Geography* as the top three subject-specific journals, pointing to shared readership with EE research. Interestingly, a recent bibliometric review of innovation systems and ecosystems (Suominen et al., 2019) shows *Research Policy* and *European Planning Studies* as the two most highly cited outlets publishing on the topic, completely mirroring our results on EE research. The top 10 most cited journals on our list account for 76.06% (2,342) of all citations, with the articles in the remaining 47 journals accounting for 23.94% (737). For researchers, these results illustrate which journals publish on the topic and which journals receive the highest number of citations.

### 3.3. Authors

EE authors belong to a variety of disciplines, ranging from international business and entrepreneurship to strategy and economic geography. We use the count numbers of articles and citations in full and fractional counting (Egghe, 2008; Waltman & van Eck, 2015) as metrics to evaluate the scholarly output and impact of individual authors to the current status of EE research (Table 5).

In terms of the publication count, the top 10 most productive authors are Roundy (9 articles), Acs (6), Audretsch (6), Szerb (5), Autio (4) and Wright (4), followed by

Stam, Qian, Feldman and Brown (3 each). Interestingly, only five authors are visible in both columns. This suggests that Autio, Acs, Szerb, Wright and Stam have continuously published in high-ranking journals and created meaningful knowledge to advance the field. Others have relatively few publications, have recently started publishing in the field or target lower-level journals for their output, thus reducing their citation counts.

As our dataset comprises 30 single-author and 123 multi-author articles, in addition to full counting of authorship and citations, for better representation of individual contributions to the field we have analysed fractional counting whereas in multi-authored articles each co-author is credited with an equal proportion of output in terms of publications and citations (Egghe, 2008; Waltman & van Eck, 2015)

Regarding productivity adjusted for co-authorship (Fractional authorship), Roundy (6.83), Audretsch (2.70) and Acs (2.58) top the list. Arguably, the first is more of a solo author, whereas the latter two have extensive collaboration networks. The other mostly solo writers are Stam (1.75), Feldman (1.50) and Spigel (1.50), whereas Qian (2.33), Szerb (1.50), Schillo (1.33) and Brown (1.25) have typically cooperated with their peers.

Regarding the total number of citations, we consider the most prominent researchers and the traction rate of their intellectual work. The most cited scholar in the EE research context are Autio (561 citations), followed by his co-authors Acs (513), Szerb (314) and Wright (291). From the top 10, Siegel (236 citations), Mustar (236) and Kenney (236) are all Autio's co-authors. Other colleagues, Stam (287 citations), Spigel (248) and Van de Ven (220), have also found their rightful place among the most cited authors. Application of fractional counting method to the number of citations (Fractional citations) provides somewhat different ranking, with Stam (233.75 citations), Spigel (224.00) and Van de Ven (220.00), Isenberg (203.00) and Acs (164.33) being the top contributors, followed by Autio (151.11), Szerb (102.41), Spilling (90.00), Feldman (75.17) and Pitelis (72.00).

Regardless of the counting method applied the same group of authors is found to be the most prolific and influential contributors shaping the development of EE research. However, because most of the work has been done in recent years, the rankings would change once the more recently published works start to attract interest.

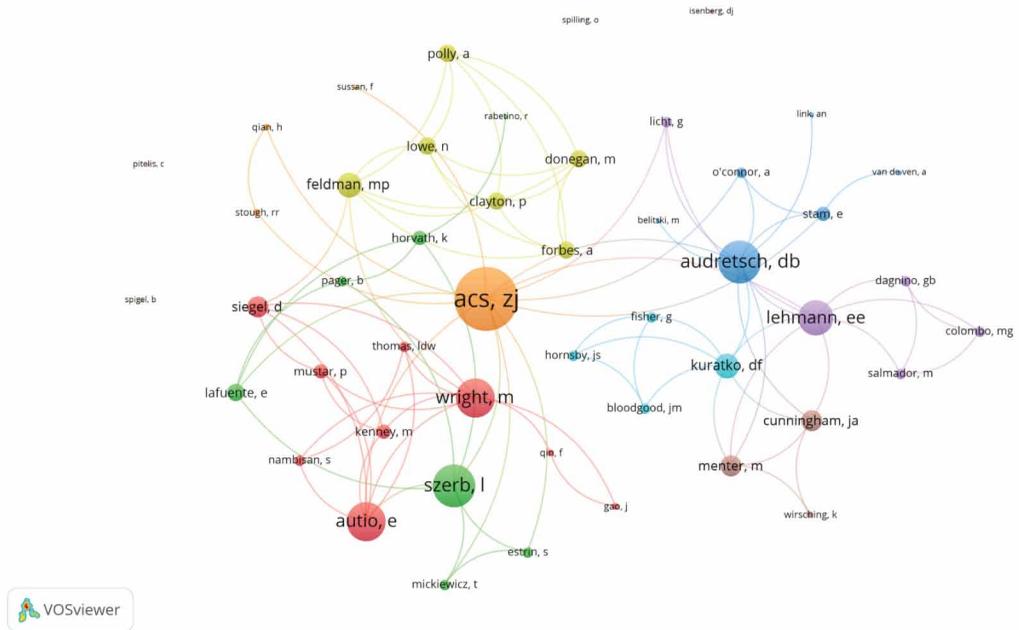
In addition to the analysis of the numbers of publications and citations, to shed more light on the EE research community, we visualise these valuable scholars' co-authorship networks (Figure 3).

Isenberg, Pitelis and Spilling have been solo authors, and Spigel has only collaborated with Harrison; therefore, their networks cannot be further depicted. However, all the other scholars are connected through their co-authorship linkages. Overall, there are 8 clusters of 44 authors within the collaboration network. Based on the number of linkages (L) to other authors and the TLS of co-authors per article, the most centrally networked scholar is Acs (L=13; TLS =18), followed by his direct connections Audretsch (L=10; TLS=12), Autio (L=8; TLS=11), Szerb (L=7; TLS=12) and Stam (L=4; TLS=4) and his indirect connections Wright (L=9; TLS=11) and

Table 5. Top 10 most valuable authors

Author	Authorship (Documents)	Author	Fractional Authorship	Author	Citations	Author	Fractional Citations
Roundy	9	Roundy	6,83	Autio	561	Stam	233,75
Acs	8	Audretsch	2,70	Acs	513	Spigel	224,00
Audretsch	6	Acs	2,58	Szerb	314	Van de Ven	220,00
Szerb	5	Qian	2,33	Wright	291	Isenberg	203,00
Autio	4	Stam	1,75	Stam	287	Acs	164,33
Wright	4	Feldman	1,50	Spigel	248	Autio	151,12
Stam	3	Spigel	1,50	Siegel	236	Szerb	102,42
Qian	3	Szerb	1,50	Kenney	236	Spilling	90,00
Feldman	3	Schillo	1,33	Mustar	236	Feldman	75,17
Brown	3	Brown	1,25	Van de Ven	220	Pitelis	72,00

Figure 3. Most central authors and their associates (by TLS)



Van de Ven (L= ; TLS=1). These extensive cooperation networks identify the most prolific authors in the EE field.

### 3.4. Journal Articles

In this section, we identify the most influential articles in EE research, who has written them, where they are published and how often they are cited (Table 6).

Accordingly, the most influential work has been published in *Research Policy* by Acs, Autio and Szerb (2014) (258 citations), focusing on the measurement and policies sustaining EE. The other seminal work has been published by Autio, Kenney, Mustar, Siegel, and Wright (2014) (236 citations), who discuss the role of entrepreneurial innovation in the ecosystem context. The next in line is Van De Ven's (1993) (220 citations) article in the *Journal of Business Venturing*, which provides a perspective on building an entrepreneurship infrastructure by setting the direction for EE inquiry. It is followed by his co-author's work, decades later in *European Planning Studies*, on the framework and systemic elements influencing entrepreneurial activities and the consequent value creation (Stam, 2015) (216 citations). One of the conceptual pieces that has intensified EE research is Isenberg's (2010) (203 citation) work, published in HBR, which identifies nine key principles that should be focused on to turbocharge venture creation. The other most influential articles have been case studies focused on demystifying the essence of the EE phenomenon (Bahrami & Evans, 1995; Neck et al., 2004; Spigel, 2017; Spilling, 1996) and its regional resources (Qian et al., 2013).

In sum, the results of the bibliometric analysis lead to several conclusions. First, we predict that the average rate of 20 citations per EE article will grow due to the majority of the research in the domain having been conducted only in recent years. Overall, the trends suggest that EE is an emerging field, and EE themes have gradually found their way into the mainstream research agenda. Second, the results from the analysis of the main countries and institutions from which EE research has originated point to the dominance of US scholarship, which is understandable because Silicon Valley is widely known as the 'golden standard' for EE in practice. Policymakers worldwide have attempted to duplicate the entrepreneurial model of Silicon Valley for a long time, and we consider these efforts to be linked to the research initiatives and the rising publication rates in the EE domain in some European countries, such as Spain, the Netherlands, Italy, Hungary and Finland. Canada and China have also shown some interest in the phenomenon. Third, the analysis results indicate that the authorship and the productivity in EE scholarship centre on several key individuals and articles that are heavily cited, seemingly serving as foundational studies from which the burgeoning research in the EE domain is drawn.

However, to clarify which articles and authors serve as foundational constituents in specific types of EE research and which research streams comprise the EE domain, the EE research corpus should first be clustered into themes and their key presumption and contributions be more comprehensively discussed. We therefore extend our analysis into cluster analysis and then elaborate on the thematic underpinnings, relevant sub-themes and the main findings of representative articles from each type of extant EE research (cluster).

#### **4. THEMATIC SYNTHESIS**

Using the direct citation method (cross-citations), we identify 139 journal articles with at least one direct citation in common – an indication of their thematic relatedness.

Table 6. Top 10 most cited articles

Cluster	Title of the Document	Authors	Journal	# Citations	Year
3	National Systems of Entrepreneurship: Measurement Issues and Policy Implications	Acs, ZJ; Autio, E; Szerb, L	Research Policy	258	2014
2	Entrepreneurial Innovation: The Importance of Context	Autio, E; Kenney, M; Mustar, P; Siegel, D; Wright, M	Research Policy	236	2014
1	The Development of an Infrastructure for Entrepreneurship	Van De Ven, AH	Journal of Business Venturing	220	1993
6	Entrepreneurial Ecosystems and Regional Policy: A Sympathetic Critique	Stam, E	European Planning Studies	216	2015
6	The Big Idea How to Start an Entrepreneurial Revolution	Isenberg, DJ	Harvard Business Review	203	2010
5	The Relational Organization of Entrepreneurial Ecosystems	Spigel, B	Entrepreneurship Theory and Practice	200	2017
1	An Entrepreneurial System View of New Venture Creation	Neck, HM; Meyer, GD; Cohen, B; Corbett, AC	Journal of Small Business Management	131	2004
1	Flexible Re-Cycling and High-Technology Entrepreneurship	Bahrami, H; Evans, S	California Management Review	107	1995
1	The Entrepreneurial System: On Entrepreneurship in the Context of a Mega-Event	Spilling, OR	Journal of Business Research	90	1996
4	Regional Systems of Entrepreneurship: The Nexus of Human Capital, Knowledge and New Firm Formation	Qian, HF; Acs, ZJ; Stough, RR	Journal of Economic Geography	80	2013

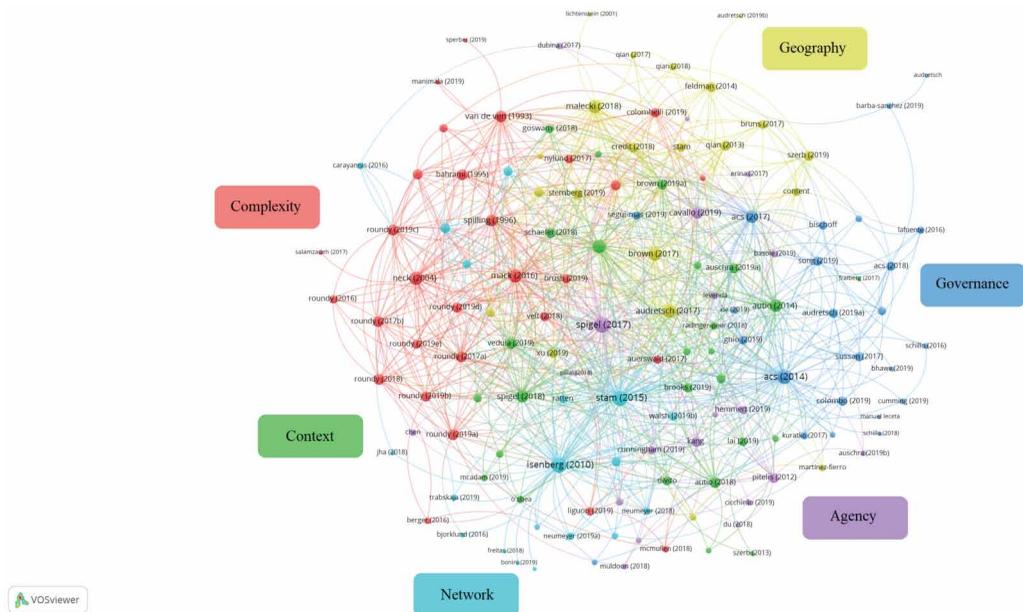
This analysis yields six thematic clusters relevant to EE research (Figure 4). Each cluster contains a comparable number of journal articles (from 29 to 19), respectively depicted as red (29; Q1=17, Q2=12), green (26; Q1=21, Q2=5), blue (24; Q1=22, Q2=2), yellow (21; Q1=14, Q2=7), purple (20; Q1=13, Q2=7) and teal (19; Q1=9, Q2=10). Based on our review of the clustered articles, several sub-themes are identified in each cluster, while clusters are subsequently labelled according to overarching themes (perspectives).

Table 7 outlines the sub-themes prevalent in each clustered thematic perspective, the main articles and their shares in each theme, the summary of the articles' main findings under each theme and consequently, each theme's title as drawn from the articles' findings, sub-themes and contents. Next, we discuss each cluster in more detail.

#### 4.1. Cluster 1: Complexity Perspective

The unifying theme of the articles in the red cluster is EE *complexity*, which they address by discussing the phenomenon's 'emergence', 'formation' and 'micro-

Figure 4. Thematic clustering of journal articles



foundations’. Emergence examines the historical presence of EEs. Van De Ven (1993) has studied the infrastructure of entrepreneurship, not as an individual endeavour but as a collective effort of numerous entrepreneurs from public and private sectors, who become the system’s driving force. The dynamic relations of their resource endowments, proprietary functions and institutional arrangements shape the entrepreneurial system. Van de Ven’s study includes observations of new environments that focus on entrepreneurial action, and the model’s prime template is evidenced in Silicon Valley in the US. Bahrami and Evans (1995) focus on the system’s antecedents, constituents and flexibility in entrepreneurial recycling. They explain that these entrepreneurial events interact with their environmental factors in creating new ventures – a symbiosis observed in other locations as well (Neck et al., 2004; Spilling, 1996).

The papers on formation draw our attention to the creation of these complex adaptive systems, which are influenced by the ‘intentionality of entrepreneurs, coherence of entrepreneurial activities, and injections of resources’, situated at the cross-section of entrepreneurial and organisational actions (Roundy et al., 2018, p. 1). This form of entrepreneurial capital creation is shaped by its community and involves a set of hybrid support organisations (e.g., development centres) that regulates the diversity and the cultural values of entrepreneurship. The creation shapes and is shaped by the surrounding ecosystem (McMullen, 2018; Roundy, 2017b). The ecosystem’s lifecycle has also been examined by scholars of this cluster. They emphasise how cultural and institutional settings affect the ecosystem’s evolution, its critical elements and their dynamic interdependencies (Mack & Mayer, 2016). They also assess the

Table 7. Main research themes

Cluster	Theme	Sub-Themes	Articles	Share #; %	Main Findings
1	Complexity Perspective	“emergence”; “formation”; “micro-foundations”	(Auerswald & Dani, 2017; Bahrami & Evans, 1995; Berger & Kuckertz, 2016; Brush et al., 2019; Colombelli et al., 2019; Hechavarria & Ingram, 2019; Liguori et al., 2019; Mack & Mayer, 2016; McMullen, 2018; Neck et al., 2004; Nylund & Cohen, 2017; Roundy, 2017, 2019; Roundy et al., 2018; Sperber & Linder, 2019; Spilling, 1996; Van De Ven, 1993)	29 / 20.9% 793 citat.	Need for infrastructure of entrepreneurship. The Silicon Valley model as the prime. Symbiosis of the environment and new venture creation. Complex adaptive systems. Hybrid meta- and support organizations. Ecosystem life-cycle, mechanics and measuring. Regional narrative reflecting configurations. Gender equality and support.
2	Context Perspective	“genesis”; “policy”; “dimension”; “actor”.	(Alvedalen & Boschma, 2017; Autio et al., 2014, 2018; Brown et al., 2019; Brown & Mawson, 2019; DiVito & Ingen-Housz, 2019; Donegan et al., 2019; Feldman et al., 2019; Fraiberg, 2017; Goswami et al., 2018; Lai & Vonortas, 2019; McAdam et al., 2019; O’Shea et al., 2019; Pugh et al., 2019; Qin et al., 2019; Radinger-Peer et al., 2018; Schäfer & Henn, 2018; Spiegel & Harrison, 2018; Theodoraki et al., 2018; Thompson et al., 2018; Vedula & Kim, 2019)	26 / 18.7% 475 citat.	Emphasis on entrepreneurial innovation. Distinctions of EE in comparison to clusters, districts, innovation systems. Utilization of various policy mixes aligned with goals. Interplay between digital and spatial dimensions. Intermediary actors initiating and accelerating entrepreneurship. Human and financial actors influencing entrepreneurial activity.
3	Governance Perspective	“lineages”; “institutions”; “knowledge”; “culture”.	(Acs et al., 2014, 2016, 2017, 2018; Audretsch, 2019; Audretsch et al., 2019; Barba-Sánchez et al., 2019; Bhawe & Zahra, 2019; Bischoff, 2019; Colombo et al., 2019; Cumming et al., 2019; Ghio et al., 2019; Horváth & Rabetino, 2019; Kuratko et al., 2017; Lafuente et al., 2016; Schillo, 2018; Schillo et al., 2016; Simmons et al., 2019; Song, 2019; Xie et al., 2019; Yan & Guan, 2019)	24 / 17.3% 481 citat.	Ecosystem as an effective resource allocation in a confined space to exploit innovations. Multisided digital platform facilitating entrepreneurial action. Appropriate governance choices to regulate internal and external factors. Institutions have positive influence towards entrepreneurial action and rate. Knowledge spillovers as a fuel of the ecosystem. Business failures as acceptable part of an entrepreneurial culture.

continued on following page

Table 7. Continued

Cluster	Theme	Sub-Themes	Articles	Share #; %	Main Findings
4	Geography Perspective	“location”; “elements”.	(Audretsch & Belitski, 2017; Audretsch & Link, 2019; Brown & Mason, 2017; Bruns et al., 2017; Content et al., 2019; Credit et al., 2018; Feldman, 2014; Lichtenstein & Lyons, 2001; Malecki, 2018; Martínez-Fierro et al., 2019; Qian, 2017; Qian et al., 2013; Stam & van de Ven, 2019; Szerb et al., 2019)	21 / 15.1% 428 citat.	Entrepreneurial ecosystems need to be studied as a locational phenomenon, separating between urban and rural contexts. Entrepreneurial activity can impact ecosystems regionally, and the regional development can result in differing regional performance and developments.
5	Agency Perspective	“agency”; “stakeholders”.	(Auschra et al., 2019; Basole et al., 2019; Carayannis et al., 2018; Cavallo et al., 2019; Chen et al., 2019; Cunningham et al., 2019; Du et al., 2018; Erina et al., 2017; Jung et al., 2017; Levenda & Tretter, 2019; Pitelis, 2012; Sarma & Sunny, 2017; Spigel, 2017)	20 / 14.4% 357 citat.	Intended and unintended agency of individual and collective actors and interdependent stakeholders influencing the emergence and development of entrepreneurial ecosystems.
6	Network Perspective	“networks”; “social capital”.	(Carayannis et al., 2016; Corrente et al., 2019; Espinoza et al., 2019; Isenberg, 2010; Neumeyer, Santos, & Morris, 2019; Neumeyer, Santos, Caetano, et al., 2019; Neumeyer & Santos, 2018; Nicotra et al., 2018; Stam, 2015)	19 / 13.7% 491 citat.	Expands and enriches the role of the network element in entrepreneurial ecosystem. Explains networks at different levels of analysis result impact the development of the entrepreneurial ecosystem.

system’s vibrancy, diversity and trajectory (Auerswald & Dani, 2017) and the various governance configurations relevant to the ecosystem’s growth (Colombelli et al., 2019).

The EE ‘micro-foundations’ are examined by debating how the ecosystem narratives are created, developed and promoted and by comparing them with other regional narratives (Roundy, 2016, 2019a). The narratives also address how the ecosystem is able to gain attention, influence cognitive reasoning and create value for its audience (Roundy & Bayer, 2019b). Each narrative reflects a different configuration of the micro-foundations and subsequently its resource dependency and resilience. Hence, appropriate strategies should be employed to mitigate risks, promote entrepreneurial activities (Roundy, 2019b; Roundy & Bayer, 2019a) and thus strengthen the connections between entrepreneurs and their surrounding meta-organisations and support organisations (Harper-Anderson, 2018; Motoyama & Knowlton, 2017; Roundy, 2017a). Perceptual techniques (Liguori et al., 2019) have been proposed to measure the micro-foundations and elaborate on which of these mechanisms (Roundy & Fayard, 2019; Villegas Mateos & Amorós, 2019) influences entrepreneurship and fosters startup development (Manimala et al., 2019; Nylund & Cohen, 2017; Salamzadeh & Kesim, 2017; Velt et al., 2018). Lastly, in line with venture development, the gender construct has become a relevant topic to EE. It is essential to recognise the factors in the ecosystem that influence or are influenced by

women entrepreneurs (Brush et al., 2019) and which configurations can encourage a high proportion of female founders in successful ecosystems (Berger & Kuckertz, 2016). Strategic choices and perceptions of the support available to both genders should also be compared when initiating and sustaining new ventures (Hechavarría & Ingram, 2019; Sperber & Linder, 2019). In sum, the studies in this first cluster comprise foundations of the initial conceptualization and framing of limits within the EE domain, conceptualizing the idea of ecosystems through distinctive theoretical lenses such as complex systems, life-cycle, or microfoundation-based perspectives.

## **4.2. Cluster 2: Context Perspective**

The green cluster focuses on the EE context by exploring the sub-themes of ‘genesis’, ‘policy’, ‘dimension’ and ‘actor’. Autio et al. (2014) discuss the levels of interrelated contexts and emphasise that the policies directed towards entrepreneurial innovation should foster EE development. This is followed by the focus on EE genesis and how it differs from previous perspectives on similar systems, such as industrial districts, knowledge clusters and regional innovation systems and clusters. The main aspects of the difference are linked to the assistance and the support offered to entrepreneurs and new venture development, the relevance of knowledge spillovers, business model innovation, opportunity capture and exploitation of digital affordances (Autio et al., 2018; Spigel & Harrison, 2018). However, further investigations are needed, not only into the location-specific institutional changes in the system, but also into the inner configurations and the cause–effects shaping the system (Alvedalen & Boschma, 2017). These shortcomings suggest that the current uniform policies do not work and that various policy mixes should be used (Szerb et al., 2013), depending on the system’s uniqueness. Recent research has highlighted the difficulties in implementing policies in practice, especially the coordination challenges and the appropriateness of the policies (Bramwell et al., 2019; Brooks et al., 2019). Public policies promoting entrepreneurial action are conceptually confusing, misinterpreted and misused as they tend to focus on entrepreneurship quantity rather than quality (Brown & Mawson, 2019). These drawbacks stem from not recognising the ecosystems’ uniqueness, their contextual limitations, their development status and the public policy’s aims.

Furthermore, the EE concept is widely considered spatially limited, with many works focusing on the regional dimension of entrepreneurship. However, attention should also be directed to the rapidly growing digital fields to signify the interplay between digital and spatial affordances (Autio et al., 2018) and to amplify the learning and knowledge spillovers from the digital domain. This shared knowledge enables entrepreneurial actors to improve their business models and technological competencies by tapping into resources external to the region (Kuebart & Ibert, 2019). Thus, digitalisation empowers horizontal knowledge sharing, in turn trickling down to the strengthening of the local community.

Such proactive learning further assists entrepreneurs in exploiting cross-regional value chains (Auschra, Schmidt, et al., 2019; Pugh et al., 2019) that may possibly generate opportunities for establishing contemporary sustainable EEs (DiVito & Ingen-

Housz, 2019; O’Shea et al., 2019; Thompson et al., 2018). Recently, scholars have drawn attention to intermediary actors who initiate and accelerate entrepreneurship by endorsing knowledge transfer and the long-term sustainability of the ecosystems’ vigour and quality (Theodoraki et al., 2018; Vedula & Kim, 2019). Such actors help build community commitment, validate the venture’s viability (Goswami et al., 2018) and extend and expand the strategic networks of startups (Brown et al., 2019; Qin et al., 2019). These mediators also facilitate other factors for ecosystem success, such as funding and human capital, which directly affect local entrepreneurial activity (Feldman et al., 2019; Lai & Vonortas, 2019). The funding is strongly linked to the presence of high-growth startups and an ecosystem framework (Lai & Vonortas, 2019; Radinger-Peer et al., 2018). As entrepreneurs and founders, human actors rely on their knowhow and experience gained across spatial and digital dimensions to foster entrepreneurial activities and build multicultural communities and EEs (Fraiberg, 2017; McAdam et al., 2019; Schäfer & Henn, 2018). Taken together, the studies in this second cluster provide, in comparison to the first cluster above, a comparatively theoretically tighter and conceptually more advanced development of understanding on the EE domain: the distinctive feature of this second cluster can be seen to be developing the conceptual distinctiveness of the entrepreneurial ecosystem concept *when compared to* other types of ecosystems in business and management research literature. Thus, whereas cluster 1 includes studies exploring the different lenses through which EE can be understood, cluster 2 focuses on contextual boundaries and limits framing the EE domain of study.

### **4.3. Cluster 3: Governance Perspective**

The blue cluster focuses on the governance aspect by exploring the sub-themes of ‘lineages’, ‘institutions’, ‘knowledge’ and ‘culture’. While the ecosystem construct has been extensively used in a variety of contexts, its lineages are seldom known. The concept has been derived from *oikos* (Greek), which refers to an effective way of resource allocation in a confined space to exploit technological innovations from which novel products and services create new value and prosperity for the world (Audretsch et al., 2019; Colombo et al., 2019). This system is driven by an entrepreneurial entity (Acs et al., 2017), while its legitimacy is continuously challenged (Kuratko et al., 2017). Nonetheless, this baseline description of an EE has been extended by its digital dimension, as explained in the previous cluster. Thus, the essence of the current EE situation is an integration of digital multisided platforms, which facilitate digital technology entrepreneurs’ knowledge sharing and utilise innovations with digital citizens as their consumers and producers, while institutions govern the whole digital infrastructure (Song, 2019; Sussan & Acs, 2017). This integration has led to a dynamic and digitally open system, shaped by numerous internal and external factors (Xie et al., 2019) that seek EE governance (Colombo et al., 2019). Governance can be understood as involving large multinational enterprises, venture capitalists and technology parks, universities and cooperative banks, and governmental institutions that encourage new venture development, provide access to networks and finance, and

improve effective managerial control (Bhawe & Zahra, 2019; Cumming et al., 2019; Ghio et al., 2019; Leceta & Könnölä, 2019).

Furthermore, ecosystem-specific institutions regulate and positively influence individual actions and entrepreneurial rates (Acs et al., 2014, 2016; Yan & Guan, 2019). Through their dynamic interdependencies, they enhance value creation and the subsequent economic growth (Acs et al., 2018). Good governing institutions enable knowledge creation and spillovers that improve system-level efficiency (Lafuente et al., 2016), as observed in the Silicon Valley model, whose recurring process of knowledge creation and commercialisation translate into profitable innovations (Audretsch, 2019). However, this is not the case for many other locations, where the model is challenging to apply and may thus lead to societal deficiencies. Nonetheless, these challenges can be overcome by other formations of entrepreneurship. For example, knowledge-intensive business services (Horváth & Rabetino, 2019), research-based spinoff companies (Schillo, 2018) and smart society models (Barba-Sánchez et al., 2019) all lead to spillovers of knowledge and human capital development and thus promote entrepreneurial readiness (Schillo et al., 2016). Hence, each location should build a sustainably customised community that promotes knowledge creation and opportunities as part of its entrepreneurial culture to boost social connectedness and buffer business failures (Bischoff, 2019; Simmons et al., 2019). In sum, this third cluster is distinguished from the previous two by its decidedly more normative lens: Whereas studies in cluster 1 started with considering different ways in which EEs could be conceptualized, and studies cluster 2 continued by framing the EE as a concept more distinctly, the studies in this cluster 3 comprise an attempt to respond to an underlying question of *who manages* the EE and *how* should EEs be governed within societies and regions.

#### **4.4. Cluster 4: Geography Perspective**

The yellow cluster is characterised by the dynamic elements of EEs, especially their location-specific advantages (LSAs), and encompasses studies on regional and locational elements. A common aspect of this stream of studies is how they seek to develop the EE concept with a meso view of cities and specific regions and locations, assuming that LSAs of particular geographic areas can be developed to attract and effectively suit firm-specific advantages (FSAs) of entrepreneurial ventures. This cluster's earliest contribution dates back to Lichtenstein and Lyons' (2001) conceptualisation of entrepreneurial development systems across different regions in the US. To 'significantly increase the rate of formation, development, and success of new enterprises within a region in a way that creates individual and community wealth', Lichtenstein & Lyons (2001, p. 4) suggest an operating programme focused on two LSAs, namely the development of entrepreneurial talent and assistance providers around them (Lichtenstein & Lyons, 2001). A special role in the LSA–FSA dynamics is devoted to knowledge as a source of entrepreneurial opportunities within the ecosystem (Feldman, 2014; Qian, 2017, 2018; Qian et al., 2013). This so-called knowledge-based regional development (Qian, 2018) view suggests that

entrepreneurship may serve as a mechanism of geographically mediated knowledge spillovers, while this mechanism's effectiveness is contingent on other factors in the regional EE (including knowledge bases, absorptive capacity, competition, networks, diversity and culture). In line with this view, the dynamic and interactive processes of the provision of knowledge-intensive services through business incubation within EEs are perceived as having a positive impact on EE development (Fernández Fernández et al., 2015). Further research may address LSA–FSA configurations in EEs from a holistic perspective, whereas fuzzy-set qualitative comparative analysis (Ragin, 2008) seems to be a particularly appealing approach for this purpose.

While ecosystem studies are often empirical and thus include a regional context in most cases, the studies in this cluster incorporate the regional aspect as a theoretical basis and a conceptual part of their argument. For example, Audretsch and Belitski's (2017) study of urban EEs uses the city as the unit of analysis. The distinct nature of such choice is emphasised by Bruns et al. (2017), who find that challenges in measuring EEs can stem from the studies' tendency to combine rural and urban regions in the same research although the resulting context can be too large to measure as an EE. This argument is linked to Brown and Mason's (2017) contention that globally, economic activity is concentrated on a small number of key cities. Accordingly, they present an archetype of ecosystems in their study. Some studies in this cluster have framed their arguments on the broader concept of 'urban centres' rather than individual cities. Qian (2017) classifies urban knowledge bases into several types and subsequently finds that certain types of knowledge can be more important in cities. Other studies in this cluster discuss contextual disadvantages pertinent to particular locations, such as peripheral position (Xu & Dobson, 2019), small size (Reidolf et al., 2019) and inadequate basic requirements (Sheriff & Muffatto, 2015), and suggest specific ways to overcome these challenges of building EEs in such locations.

Adopting an even broader perspective by assessing entire regions, some studies in this cluster find that a region's economic potential has an impact on its EE (Martínez-Fierro et al., 2019) and that the prevalence of high-growth firms in a region has a positive relationship with that region's EE (Stam & van de Ven, 2019). Such studies are based on the seminal work of Feldman (2014), who introduced a two-way relationship between entrepreneurs as key agents of change in communities and how they benefit from the communities. The LSAs of EEs explain how entrepreneurial activity is strengthened by the region and how the impact of that activity adds overall value to the region (Content et al., 2019). These studies also outline how regional EEs can influence the success (regional performance) of individual regions (Szerb et al., 2019). Taken together, the studies in this cluster introduce plurality into the EE domain by changing geography-related elements from mere empirics to vital ingredients of conceptual and theoretical development.

#### **4.5. Cluster 5: Agency Perspective**

The purple cluster discusses both intended and unintended agencies of individual and collective actors, resulting in EE emergence and development. The early papers

in this cluster have considered the role of individual entrepreneurs' strategic choices of location (Pitelis, 2012) and the role of governmental policies (Kshetri, 2014) in EE development. While individual entrepreneurial agency has been further advanced by Spigel (2017) and Basole et al. (2019), the discussion on national authorities in EE development has been extended by two other articles in this cluster (Cicchiello, 2019; Jung et al., 2017).

Spigel (2017) proposes a theoretical model of EEs, comprising 10 cultural, social and material attributes, whose different configurations create various sets of benefits and resources for entrepreneurship. The distinctiveness of these benefits and resources in turn enables and facilitates entrepreneurial agency, contributing to the development and the reproduction of heterogeneous EEs. Building on Spigel's (2017) model of EEs' relational organisation, Basole et al. (2019) examine strategic positioning statements of 24,068 ventures to depict the structures of 35 EEs. Their study showcases the formative nature of a situated entrepreneurial agency and the respective agentic tradeoffs between legitimation and differentiation in the development of heterogeneous EEs in terms of size, structure and composition (Basole et al., 2019).

Regarding the government's role in EE development, a comparison of Estonian and South Korean cases reveals possible multiple paths to success (Kshetri, 2014). A more recent study on the assessment of various stakeholders' views about South Korea's current government-driven EEs reveals the prevalence of a less optimistic outlook on overall EE development and prospects. It outlines several critical obstacles, such as an inappropriate joint surety system, an unfair competition ecosystem from large conglomerate companies and 'unstable political agenda without durable institutional settings' (Jung et al., 2017, p. 843). Another critical study, this time in the European context, evaluates national regulatory frameworks for crowdfunding. It finds that 'European countries have approached crowdfunding regulation very differently creating sometimes barriers to the development of their own national crowdfunding markets' (Cicchiello, 2019, p. 304). The study argues that the imposed local regulatory frameworks, related to new forms of entrepreneurial finance (e.g., equity crowdfunding), inhibit access to financial resources, which constitute the key element of a vibrant EE. Moreover, heterogeneous policies among European countries prevent cross-border crowdfunding schemes in the European market, thus limiting the scaling up of crowdfunding platforms (Cicchiello, 2019). Overall, the government's role in promoting EEs seems very challenging and problematic, whereas an intended developmental agency might lead to unintended detrimental consequences.

In addition to these two sub-themes, another dominant idea in this cluster involves the drivers of agentic actions that result in EE emergence and development, including the facilitating roles of trust (Muldoon et al., 2018) and sociocultural capital (Pillai & Ahamat, 2018) or the impact of national differences in EE formation (Hemmert et al., 2019). Building on earlier views on EE development focusing on individual entrepreneurs and governments, some works have adopted more holistic approaches towards considering the collective agency within various multi-agentic systems, such as smart-city (Sarma & Sunny, 2017), technopolis (Levenda & Tretter, 2019), meta-

organisation (Du et al., 2018), helix (Carayannis et al., 2018; Dubina et al., 2017; Erina et al., 2017) or project-based/like organising (Auschra, Braun, et al., 2019; Cunningham et al., 2019). In a nutshell, this cluster emphasises the role of agency as a foundational principle for the effective development of an EE as a self-regulating, multi-agentic symbiotic system.

#### **4.6. Cluster 6: Network Perspective**

The teal cluster focuses on networks. Using the lens of networks of interacting actors, the studies in this cluster explain the development and the evaluation of regional and national EE frameworks. These studies clearly link to Isenberg's (2010) foundational work, which emphasises the interconnectedness of individual elements, elaborates on the key principles influencing the system and notes that the ecosystem should include a sufficient number of non-profit and industry associations to facilitate entrepreneurial networking and investments. Another pivotal study on the ecosystem domain (Stam, 2015) outlines the main elements, outputs and outcomes of the EE concept, including 'networks', which address the ecosystem's network density.

More recent studies in this cluster have examined other issues, such as how social capital promotes knowledge acquisition of ventures (Carayannis et al., 2016) and what is the social network connectivity of ventures with different types of business models (Neumeyer & Santos, 2018). Nicotra et al. (2018) incorporate social capital as one of the sub-elements in their framework for EE cause-effect relations, following it up with an ecosystem comparison (Corrente et al., 2019). Interestingly, Corrente et al. (2019, p. 488) indirectly criticise the presumed prominent role of networks in EE research: '... the concept of the ecosystem applied to entrepreneurship relates to the capacity of a territory to create a system of actors and infrastructures supporting the creation and development of innovative business projects, beyond the mere construction of a network structure between companies ...'. Neumeyer et al. (2019) counter this view by not only applying the social network theory to the conceptualisation of EEs as 'complex social constructs' but also modelling ecosystems precisely through networks of individuals.

Overall, while the inclusion of Isenberg's (2010) and Stam's (2015) seminal studies in this cluster may suggest that network-based research on EE is theoretically sound and unanimous, the opposite seems to be the case. Nonetheless, a common thread running through the studies in this cluster is their attempt to explain EE development via interactions among actors, who can be individual entrepreneurs (Neumeyer et al., 2019), their ventures (Carayannis et al., 2016), regions or even entire ecosystems (Corrente et al., 2019). Thus, while networks and social capital are the unifying themes of the studies in this cluster, their presumptions, units of analysis and consequently, their findings and implications vary considerably.

### **5. DISCUSSION AND CONCLUSION**

In this study, our objective was to summarise the extant EE literature and to consolidate several disciplines that are gradually being permeated by EE research

(e.g., international business, entrepreneurship, and regional studies). We have applied bibliometric methods because of their rigour, relative objectiveness (Zupic & Čater, 2015) and the recent emphasis on bibliometric studies about entrepreneurship in general (Lampe et al., 2019) and EE research in particular (Credit et al., 2018; Malecki, 2018). Compared with other bibliometric studies in the EE context (Alvedalen & Boschma, 2017; Credit et al., 2018; Malecki, 2018), our study is favourably distinct and to our knowledge, appears to be the first full-fledged bibliometric analysis of the emerging domain. By utilising a broad array of bibliometric data and techniques, we provide comprehensive mapping of the EE research domain and the synthesis further extends our contribution to the substance of the subject.

Our study's findings offer several insights into the status quo of the EE domain. Recent years have witnessed an exponential growth in EE studies, which can be characterised as an explosion of research attention. This trend is particularly evident in comparison to more mature fields of clusters and innovation systems (García-Lillo et al., 2018; Suominen et al., 2019). Since 2016, scholars of economic geography, as well as entrepreneurship, strategic management and international business, have increasingly contributed to EE research.

This proliferation is also reflected in publication outlets, where our analysis shows a heterogeneous dispersion of studies across various disciplines. Notably, despite the relatively nascent stage of EE research, between 1993 and 2019, over 100 articles were published in journals classified in the top quartile (Q1) per the SJR. These recent developments indicate the surge in the topic's relevance and popularity in the business literature.

Our study's findings also highlight the clear authority of several influential scholars representing the domain's significant generative mechanisms, also known as *invisible colleges* (Crane, 1969; Vogel, 2012). Notably, these scholars have not only published articles and been cited widely but have also opened new avenues of research in the domain and have triggered the emergence of particular perspectives, with their contributions being pivotal to the thematic clusters. In addition, the presence of other esteemed generalist scholars further contributes to the legitimisation of the domain outside the field's immediate circle of authors. For the field to progress, it is important to have diverse authors working along the periphery, as well as new and independent authors infusing fresh ideas that are not bound by existing intellectual structures or network dynamics.

In sum, while recently on the rise in academia, the EE remains a largely practitioner-centred topic with limited empirical, conceptual and theoretical grounds (Autio et al., 2018; Colombo et al., 2019). Thus, a long but promising path must be traversed to further develop the EE research agenda. Drawing on this study's results, it would be of significant interest to observe whether and how the research domain progresses through development stages towards maturity and the so-called normal science or otherwise burnout as yet another rapidly emerging academic hotspot (Audretsch et al., 2019). So far, our study reveals that the EE scholarly community's attempts seem notably structured and cumulative. Our analysis of the clusters shows that more recent

contributions tend to follow research avenues chartered by earlier works within a particular cluster. On the other hand, our analysis also reveals substantial linkages between the clusters. As we believe that some of the key unanswered questions in EE research can only be solved having a systematic understanding of the entire domain and advancements in all of its knowledge clusters. For instance, in order to address the burning issue of governance, integration of knowledge from other clusters within EE research might be found valuable. As intervention in an ecosystem is considered potentially hazardous (Stam, 2015) and violates the self-regulating principles of ecosystems, serious concerns have been raised about whether and how EEs are governed in theory and practice and the effectiveness of applying the main tenets of the governance literature to EEs. To address this open question within governance perspective researchers may draw from the agency cluster where EE is seen a self-regulating, multi-agentic symbiotic system. In particular, the governance of EEs might be considered through the prism of adjustments in incentives for agency. To identify the agency of which particular actor within emerging ecosystem is under incentivised and thus inhibiting a desired development of EE, the geography perspective seems particularly useful with the analysis of interrelationships between locational advantages and resources required by ecosystem actors. The complexity perspective in turn outlines the dynamics between interrelated elements and actors involved in the ecosystem development, whereas the context perspective allows for heterogeneity of various contextual forces affecting entrepreneurial ecosystems. Thus, our study may help researchers to grasp and connect the complex, interdisciplinary and fragmented knowledge on entrepreneurial ecosystems and trigger further research on the topic.

In conclusion, we recognise that bibliometric research warrants technological choices and delimitations, both of which impose some limitations. For instance, the WoS database does not index all relevant publications in the EE field; thus, certain publications relevant to the research corpus have possibly been overlooked. However, Scopus and Google Scholar have similar drawbacks, with some missing listings and metadata. Thus, it is necessary to also focus on peer-reviewed studies published in reputable academic journals. Nevertheless, the initially omitted publications impacting other EE publications have further been supplemented via the co-citation analysis on the cited reference lists. These limitations point to the need for a systematic literature review by mining publications from multiple academic databases. Similarly, we have tracked the patterns between country-level activity and thematic clusters from our analysis outputs but have not obtained interesting results, most likely because most EE research is international and collaborative. More narrowly focused future research on patterns of country-level activity in the domain might examine this issue more closely. Furthermore, while most EE studies have been published in the last couple of years, nearly in each of the six clusters, the possibility to analyse the domain's evolution dynamically represents another prospective opportunity.

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## ENDNOTES

- <sup>1</sup> Authors can be affiliated with multiple institutions in different countries, while co-authoring with others.
- <sup>2</sup> Defined based on the journal's h papers published which each have been cited at least h times.

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